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GROWING FIELD BEANS IN HUMID AREAS

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Importance of the Edible Field Bean Crop

In recent years the crop of (dry) edible field beans in the United States has ranged generally from about 10 to 15 million bags of 100 pounds each, with a farm value of 40 to 50 million dollars. East of the Mississippi River, about 700,000 acres, yielding about 5 million bags, were grown annually from 1929 to 1938, while about a million acres, yielding about 8 million bags, were grown in States farther west. Yields varied from less than 400 pounds per acre in some States to over 1,000 pounds in others.

Over 90 percent of the beans grown in the East in recent years have been produced in Michigan and New York, with small quantities coming from Maine, Wisconsin, Vermont, and other States.

In a leaflet only general directions and comments can be given on the principal factors and operations involved in growing dry beans. For more detailed information applying to local conditions, growers should consult their State agricultural experiment stations, extension specialists, and county agents.

Climatic and Soil Requirements

The bean is a warm-season crop that will be damaged by the least frost, but it does not thrive under the heat of midsummer in the southern part of the United States, where production is largely unprofitable also because of serious and almost unavoidable infestations by bean weevils (p. 5). Dried beans should be produced only in areas where heavy or frequent rains do not usually occur during the ripening and harvesting periods. Probably they could be produced east of the Mississippi in new areas where the summers are mild and the rainfall in late summer and early fall is rather light.

Field beans are grown successfully on a wide variety of soil types ranging from light sandy loams to clays. Moderately fertile well-drained sandy loams and silt loams are best. Excessively fertile soils produce an undesirably heavy vine growth without a proportionate yield of seed, and poorly drained soils are conducive to disease and retarded growth.

Use Good Varieties and Seeds

In the humid bean-growing areas, chiefly Michigan and New York, the white pea bean, or navy bean, is grown far more extensively than any other. Of the many varieties and strains of this market type, the Robust is probably the most important because it is almost immune to common bean mosaic and is less susceptible than many other varieties to other diseases. However, it is 4 to 7 days later than common pea bean strains, which are very susceptible to mosaic.

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The new Michelite variety is somewhat resistant to mosaic and 2 to 5 days earlier than Robust.

Red Kidney is the second important type of beans grown in humid regions. The old strain of Red Kidney was very susceptible to disease, but some present strains are less susceptible to anthracnose.

White Marrow, Yellow Eye, and White Kidney yield well but are of minor importance because there is less general demand for them than for other types.

Pea beans are the earliest, maturing in 110 to 120 days. Marrow and Yellow Eye beans average about 5 days later and Red Kidneys are still later. A frost-free season of less than 140 days is not safe for Red Kidneys.

The white varieties especially need a harvest period comparatively free of rain so that they will not become discolored by weathering, but the Red Kidneys do not show so much weathering in wet seasons.

Many varieties that are grown extensively in the West as a dry-land crop or under irrigation are not adapted to culture in the humid East. Among these are Great Northern, Pinto, Small White, Pink, and Small Red.

Growers should take special care to obtain the best seed available for planting instead of using ordinary market stock. Local agricultural advisors and State experiment stations and extension services can refer growers to sources of seed produced under careful supervision and meeting good standards. Certain bean diseases are seed-borne, so it is essential to obtain seed that is relatively free from disease, as well as being true to type and of a productive strain.

In general, one should grow one or another of the more important types being grown in one's own locality because there is better probability of its fitting in with the local handling, cleaning, and marketing facilities.

Growing the Crop

Grow Beans in a Rotation

Beans harvested as dry seeds are normally grown as an extensive field crop rather than an intensive garden crop. They fit well into the general farm rotation in those areas to which they are adapted.

A very satisfactory rotation followed in the New York bean districts is (1) beans, (2) winter wheat, (3) clover and timothy, (4) timothy. In Michigan a common rotation is (1) beans, (2) small grains seeded with clover, (3) clover. Corn or potatoes fit well in such a rotation either before or after beans. Longer rotations are developed by seeding other pasture crops with the clover and pasturing them or cutting for hay for 2 years or more.

Prepare the Soil Thoroughly

Land for beans should be fall-plowed if practicable, especially if the soil is heavy or if there are much coarse growth and many weeds to plow under. Early-spring plowing will suffice if a firm, uniform seedbed free from trash can be produced. A deep, firm seedbed free from clods and coarse debris is a necessity if good germination and a good stand are to be obtained. Large amounts of decaying organic matter may be conducive to maggot injury (p. 6). The cultipacker and the roller are very generally used after disking and harrowing to reduce clods and firm the soil.

Applying Fertilizers

Large quantities of commercial fertilizer are rarely profitable on field beans as they are usually grown. Extensive studies by the Michigan Agricultural Experiment Station show that broadcasting the fertilizer or applying it with the seed through the drill is generally unprofitable. If fertilizer is used, it should be applied at planting in a band about 1½ to 2 inches to one side of the seed and about 1½ inches deeper than the seed. Not over 300 pounds per acre of 4–16–4 or 0–16–4 fertilizer is recommended. Experience indicates that on most fairly good soils it will be more profitable to build up the soil with manure or green manure and use the fertilizer on preceding crops that give greater responses than beans do. Very light or poor soils should not be planted to beans, even if fertilized, because the results are too often unprofitable.

Planting

Beans should be planted only after the soil is well warmed and all danger of late frost is past—at about the same time as corn. They can be sown with a grain drill having only every fourth drill hole open—making rows 28 inches apart—or with a 2-row corn planter equipped with bean plates and narrowed to about 30 inches.

The seed should be planted no deeper than necessary to insure their being kept thoroughly moist until the seedlings emerge. On the heavy soils plant not over 1 inch deep and on the lighter soils about 1½ inches deep. If planted with a grain drill the soil should be firmed with a roller immediately after planting. Corn or bean planters have wheels that firm the soil over the seed, making rolling rarely necessary after planting.

Pea beans should be planted at the rate of approximately 45 pounds (3 pecks) per acre and kidney beans about 75 pounds (5 pecks) per acre. This heavier weight is necessary chiefly because the kidney beans are much larger than pea beans and not because more plants are needed per acre.

Cultivation

Many of the roots of beans lie near the soil surface and will be damaged by deep cultivation. Cultivators with numerous small shovels or blades that work at a shallow depth should be used. Various sweeps that are drawn just below the soil surface are desirable, since they destroy weeds without going deep enough to damage the roots of the beans.

The crop should be cultivated no oftener and no deeper than necessary to keep weeds under control. Four or five cultivations are usually enough if the soil has been properly prepared and cultivation is properly done.

Do not cultivate beans when the plants are wet with rain or dew—such cultivation may seriously spread disease.

Harvesting and Handling

Field beans should be harvested when most of the pods are yellow and beginning to dry but before the seeds begin to shatter out of the pods, and if possible when fair weather is predicted. The plants are generally harvested by a bean cutter (fig. 1) with large knives that slip under the soil, cutting off or pulling out two rows of plants and leaving

them in a windrow. After drying a few hours, several windrows are thrown together with forks or a side-delivery rake to make large windrows convenient for stacking.

Bean stacks must be carefully built if they are to protect the beans from weathering. The stack is built as follows:[1]

Drive into the ground until firm a smooth post 2 to 2½ inches in diameter and long enough to stand about 5 feet above ground. Place around the post a straw base 4 feet in diameter and high enough to be about 6 inches thick after settling. The beans from the windrows are then stacked uniformly and firmly around the post to form a straight-sided stack, carrying the width well up to about a foot above

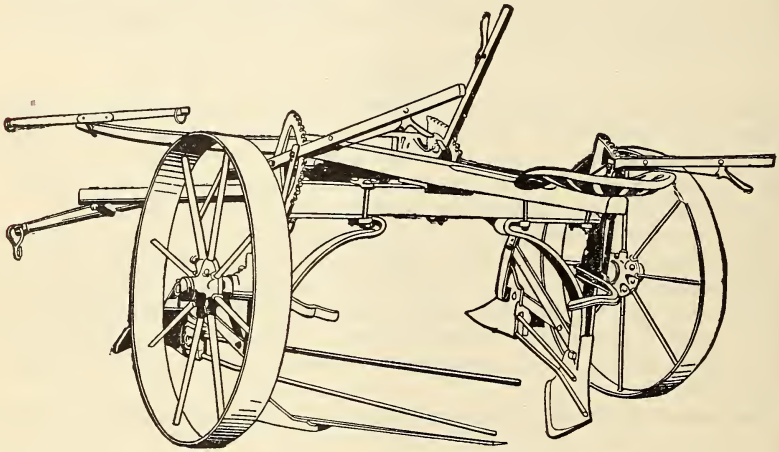

FIGURE 1.—A two-row bean harvester.

the stake. The stack is then finished with a firm well-rounded top reaching about 2½ feet above the stake. About a dozen stacks per acre are normally required.

If the beans are well-matured the stacks may be built 4 to 4½ feet in diameter, but never larger. If the beans have not completely matured, the stacks should be only about 3 feet in diameter to permit more rapid drying of the beans and to prevent heating. The base of the stack must be kept narrow so that it will not be so wide as to result in poor aeration and heating after the stack settles.

Many field beans are cured in small piles, left exposed to the weather, but this method results in serious loss of quality if the beans are rained upon. After rain the vines must be spread out to dry and then repiled. This requires a great deal of labor, as much or more than stacking, and still results in more defective beans than if they are properly stacked or placed in barns or sheds.

In the East beans are generally threshed with threshing machines designed especially for beans. Common grain threshers damage too many of the beans to be suitable. Growers contemplating the

[1] See Mich. Agr. Expt. Sta. Spec. Bul. 276, Field Stacking for Michigan Beans. 1936.

production of beans should be sure that threshing, cleaning, and picking facilities will be available for handling the crop.

After threshing, the beans are put through a cleaning mill and then weighed. These are called "unpicked" beans because beans that are discolored or show undesirable characters that the cleaning mills cannot remove must still be picked out. Most beans are now marketed on the "hand-picked" basis, and the grower is paid only for the good beans that are suitable for sending on to the ultimate consumer. Besides receiving nothing for the defective beans that must be picked out of his threshed and cleaned beans, the grower must pay for the work. Thus, it is essential that beans of the highest quality possible be produced and they must be carefully protected after harvest if serious deductions for poor quality are to be avoided.

Standards

United States Standards for Beans [2] sets forth the maximum amounts of splits, other damage, other classes of beans, and foreign material allowable in each market grade and market class of beans. Growers should be familiar with these standards so that they will know in advance the quality of product that is required for each market grade and can take precautions to avoid waste and low quality.

Insects and Their Control [3]

Bean Weevil

The bean weevil is such a serious pest in regions having mild winters that beans can rarely be grown at a profit in such regions. Even in the more northerly States where most of the country's beans are grown, this weevil is a major problem. The beans may become infested either in the field or in storage, or both. There follow a number of control methods that should all be carefully followed: [4]

(1) Plant weevil-free seed. * * * (2) Harvest and thresh or shell all seeds from weevil-infested fields as soon as they are ripe. * * * (3) Immediately after they are harvested [and threshed], place the seeds in tight bags having at least 24 strands to the linear inch. * * * (4) Fumigate infested seeds as soon as possible after harvest. * * * (5) Eliminate all shattered seeds and other crop remnants that may remain on the field surface after harvest, by clean plowing, burning, pasturing with livestock, or any other available method. * * * [6] Clean up possible hibernating or overwintering quarters of weevils, adjacent to or near cultivated fields, such as brush-filled fence rows, abandoned orchards, and dilapidated fences and buildings. * * * [7] Beans, cowpeas, or peas stored on the farm, in warehouses, or in other storage places should be examined at frequent intervals and fumigated when necessary.

Fumigation should not be undertaken without thorough information and preparation. It is hazardous. Farmers' Bulletin 1275, Weevils in Beans and Peas, discusses in detail fumigation and other methods of control of weevils.

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[2] Obtainable from the Agricultural Marketing Administration, U. S. Department of Agriculture, Washington, D. C.

[3] Prepared in cooperation with W. H. White, Division of Truck Crop and Garden Insect Investigations, Bureau of Entomology and Plant Quarantine.

[4] Quoted in brief from Farmers' Bulletin 1275.

Seed-Corn Maggot

The seed-corn maggot, or bean maggot, attacks the germinating seed or the seedling in the soil. It may destroy the seed before the seedling can emerge, or it may only result in damaged and unproductive seedlings. This insect is especially destructive in cold, wet soils in the spring and in soils containing large quantities of partly decayed organic matter. There is no known method of control after infestation occurs, so preventive measures must always be taken against it.

Damage by the seed-corn maggot can best be avoided or minimized by careful attention to the following:

(1) Plant beans only on soil in which green manure, cover crops, weeds, and sod have been turned under long enough to become well-rotted. (2) Plant relatively shallow in warm, well-drained soil. (3) Avoid applying manure immediately before growing beans. (4) Avoid the use of commercial fertilizers high in organic constituents, such as bone, tankage, and fish scrap. (5) Avoid planting at a time the maggots are known to be abundant in the soil.

Bean Leafhopper

The bean leafhopper is a very small green insect that feeds from the under sides of the bean leaves, sucking the juices from the tissues. During the feeding process it imparts to the plant a toxic substance that causes a curling of the leaves and stunting of the plant called hopperburn.

The bean leafhopper is controlled by sulfur dust at the rate of 15 to 20 pounds per acre per application directed to the under sides of the leaves. The first application should be made at the time the first leafhoppers can be found, and 2 or 3 applications should be made at intervals of 6 or 7 days. If the infestation becomes severe, it is necessary to use a dust composed of 95 parts of sulfur and 5 parts of pyrethrum powder containing approximately 1 percent of pyrethrins, at the rate of 20 pounds per acre. Early treatment is essential for satisfactory control.

Mexican Bean Beetle

The Mexican bean beetle is a serious pest of beans and sometimes becomes destructive in southern New York and northward into Maine. The adult beetle passes the winter in woodlands near old bean fields. Upon emergence in the spring, the females lay clusters of yellow eggs on the under sides of the bean leaves. From these eggs yellow "fuzzy" larvae appear, which feed in groups on the under sides of the leaves, removing the epidermis. They seldom cut through to the upper surface; therefore, any control remedy must be applied to the under surfaces of the bean leaves.

Spray or dust with derris, cube, pyrethrum, or cryolite. Spraying has given better results than dusting. Any of these insecticides applied to the beans *so as to cover the under sides of the leaves thoroughly* will protect the plants:

To prepare a derris or cube spray, use finely ground derris or cube root (4-percent rotenone content) at the rate of ½ ounce (3 level tablespoonfuls) to 1 gallon of water; or 1½ ounces (10 level tablespoonfuls) to 3 gallons; or 1½ pounds to 50 gallons.

To prepare a cryolite spray, use 1 ounce (3 level tablespoonfuls) of cryolite to 1 gallon of water; or 3 ounces (9 level tablespoonfuls) to 3 gallons; or 3 pounds to 50 gallons.

To prepare a derris or cube dust, containing 0.5 percent of rotenone, use 10 ounces of finely ground derris or cube root (4-percent rotenone content) to 4 pounds 6 ounces of diluent (finely ground talc, clay, sulfur, tobacco, gypsum, or other powder except lime); or 12½ pounds to 87½ pounds of the diluent.

To prepare a cryolite dust, use 3 pounds of cryolite to 2 pounds of diluent (finely ground talc or sulfur); or 60 pounds of cryolite to 40 pounds of the diluent.

A pyrethrum dust containing approximately 0.5 percent of total pyrethrins, or an impregnated dust containing approximately 0.3 percent of total pyrethrins, may also be used to good advantage. During the present emergency it is recommended that whenever possible these be substituted for dust mixtures containing cryolite or rotenone.

The first application of insecticide (spray or dust) should be made when the adult bean beetles are first seen in the field or when eggs are found on the leaves. Repeat every week or 10 days if the insects are numerous. Four treatments at 10-day intervals will usually protect the crop even in seasons when the beetle is abundant.

Diseases and Their Control[5]

In the East, field beans are subject to attack by a number of different bacteria and fungi, some of which cause serious losses to the crop, while others are of little or no economic importance. The diseases of beans may be divided roughly into three general groups: (1) Those caused by parasites that attack the plant above ground, (2) those caused by parasites that are restricted to the roots and stems, and (3) virus diseases, such as mosaic.

The parasites, except the blight and anthracnose organisms, that attack the leaves are usually not of much economic importance and consequently the application of artificial control measures is seldom necessary.

The diseases of the second group include root rots and wilts. Root rots are caused by a number of different germs that cause decay of the primary and lateral roots, thereby shutting off the movement of food material from the roots to the above-ground parts of the plant. The wilt organisms invade the water-carrying vessels of the stem and retard the flow of water to the leaves. Against the root rots, wilts, and certain leaf diseases only preventive measures are practicable.

The only controls against bean mosaic are the use of resistant varieties and of the less sure preventive, mosaic-free seed.

Clean Seed

By "clean seed" is meant seed that does not carry disease germs on or in the seed coat, or virus in the seed. Three of the most serious diseases of beans (anthracnose, bacterial blight, and mosaic) are seed-borne and can be controlled to a large extent by the use of seed free of the disease even though it is planted in regions where the diseases generally occur. Disease-free seed must be planted each year.

Seed of garden or snap bean varieties is produced mainly in the arid West, in areas where blights and anthracnose are less likely to result in infected seed than if produced in the humid East. Of the

[5] For further information on bean diseases, see Farmers' Bulletin 1692, Bean Diseases and Their Control.

dry field beans grown in the East, only Red Kidney is also grown extensively in the West, so that western seed of pea beans and of the less common eastern types is not generally available.

Resistant Varieties

There are no varieties of beans resistant to the root rots and wilt. Under average conditions, however, Robust and Michelite are resistant to mosaic and only moderately susceptible to anthracnose and bacterial blights. Red Kidney, White Imperial, and Perry Marrow are moderately resistant to anthracnose, and Red Kidney and Perry Marrow are also less susceptible to bacterial blights than most varieties.

Crop Rotation in Relation to Disease Control

The value of crop rotation as a means of disease control has frequently been overestimated. Many disease-producing organisms live a long time in the soil, even in the absence of beans or other susceptible hosts. Some of the organisms causing root diseases of beans can live almost indefinitely on the decaying vegetable matter of almost all plants. In view of that fact, complete eradication by means of crop rotation must not be expected. Experiments have shown, however, that some reduction in crop losses and in the amount of disease is obtained if the rotation is not too short. A good rotation will also doubtless help prevent a rapid build-up of soil-borne disease-producing organisms.

If beans have been grown on the soil several years in succession and the root rots and other diseases have become troublesome, it is advisable, if possible, to adopt a system of rotation that will bring beans on the same land not oftener than once in every 3 or more years.

Seed Treatment

Seed treatment has been recommended and to some extent practiced as a means of disease control. The results have been too variable and uncertain to recommend it as a general practice. The most beneficial results are likely to be obtained in very early plantings if the soil is wet and cold. Under such conditions the disinfectant may protect the seed from rotting until it has a chance to germinate. On the other hand, seed treatment is likely to be of little value if the weather is sufficiently warm and otherwise favorable for quick germination.

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